Comparison of Larval vs. Fingerling Hybrid Striped Bass Stockings in Lake Sam Rayburn, Texas

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Abstract: Success and cost effectiveness of stocking larval vs. fingerling hybrid striped bass (♂ *Morone chrysops* × ♀ *M. saxatilis*) were evaluated at Lake Sam Rayburn, Texas. Stocking success was evaluated using gill net catch rates of age-2 hybrids, mean length of hybrids at age 2, and relative annual mortality of stocked individuals. Hatchery production and stocking cost of larvae and fingerlings were compared. There was no significant difference between gill net catch rates of age-2 hybrids stocked as larvae vs. fingerlings. However, age-2 hybrids from larval stockings were significantly larger than those from fingerling stockings. Relative annual mortality of stocked larvae was significantly higher than for fingerlings. Stocking costs for larvae were less than half those for fingerlings. The lower cost per age-2 recruit and faster growth of hybrids stocked as 3-day-old larvae justified stocking larvae over fingerlings in Lake Sam Rayburn and could provide significantly lower costs for establishing a hybrid striped bass fishery in any reservoir.

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Hybrid striped bass (♂ *Morone chrysops* × ♀ *M. saxatilis*) have been stocked in numerous lakes in the United States and have become important sport fishes (Bishop 1967, Williams 1970, Ware 1974, Crandall 1978, Prentice 1987). They can provide excellent fishing within 2 years of stocking (McIlwain 1984) and have been successful in waters exceeding 2,000 ha (Glass and Maughan 1985).

An important aspect of successful stocking programs is minimizing production and distribution costs, while maintaining acceptable angler catch rates (Moss and Lawson 1982). Since hybrids were first produced, both larvae and fingerlings have been stocked with varying degrees of success (Ware 1974). However, no studies have compared relative success and production costs between larval and fingerling stockings in a lake where both stockings were used successfully.

Hybrid striped bass were first produced in 1965, but limited hatchery pond space in most states precluded large scale fingerling production (Ware 1974). Because of

this shortage of hybrid fingerlings, most early stocking attempts were made using larvae, and several successful fisheries were established (Bishop 1967, Williams 1970). Based on previous studies conducted using striped bass, most larvae were stocked 5–6 days after hatching since feeding commenced at this time (Bayless 1972).

By 1972 pond space had become available in Texas, and the Texas Parks and Wildlife Department (TPWD) reported excellent returns (74%) for fish reared to fingerlings in state fish hatcheries (Ware 1974). Positive results of fingerling stockings encouraged many states to begin producing and stocking hybrid fingerlings. Since that time, stocking programs have used fingerlings almost exclusively.

Hybrid fingerlings (40–60 mm total length) were successfully stocked in Lake Sam Rayburn in June 1979 and 1981 at rates of 12 and 10 per ha, respectively. In 1982, limited pond production space forced TPWD to again consider stockings of 5-day-old larvae. However, high water temperatures (20–22 C) and limited aquarium space forced biologists to stock the larvae as soon as mouth parts were present, usually between 60 and 72 hours. Three-day-old larvae (22/ha) were stocked in April 1982. Reports by anglers and observations made during normal sampling procedures indicated that this stocking was successful. Stockings with 3-day-old hybrid larvae were repeated in 1985 and 1987 at rates of 22 and 32 per ha, respectively. This study compared the success and cost effectiveness of these stockings of 3-day-old larvae with previous fingerling stockings in Lake Sam Rayburn, Texas.

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Methods

Lake Sam Rayburn is a 46,338-ha reservoir impounded in 1965 on the Angelina River in southeast Texas by the U.S. Army Corps of Engineers. The reservoir has a drainage area of 8,935 km^2, 900 km of shoreline, and a shoreline development index of 12. Maximum and mean depths are 28 m and 4 m, respectively (Seidensticker 1988).

Lake Sam Rayburn was sampled with gill nets during January 1981, 1983, 1984, 1987, and 1989. Nets were 61 m long, constructed of 8 monofilament panels (7.6 m long and 2.4 m deep). Mesh sizes ranged from 1.3–10.2 cm bar mesh in 1.3-cm increments. Fifteen nets were set overnight once during every sample period. Sample sites were the same for all periods. All fish were measured to the nearest mm total length. Catch per effort (CPUE) was recorded as catch per net night. A net night is defined as 1 net set overnight (approximately sunset to sunrise). Differences in catch rates (annual means) and mean total lengths of hybrids from larval and fingerling stockings were evaluated using a *t*-test ($P = 0.05$) with unequal sample sizes (SAS 1982). Age-2 hybrids were used for comparison purposes because these fish were the most numerous age group in the gill net samples, were near or above the Texas minimum length limit of 457 mm, and were considered to be recruited into the fishery. Age was determined using scales (Gutreuter 1987) and

length frequencies. Since no creel data were available during this study, the effects of angling pressure were assumed to be equal on all year classes.

Relative annual mortality (RM) for each year class of age 2 hybrids was estimated using the formula RM = $-[\ln(Nc/Ns)]/t$; where *Nc* = number of fish collected from a particular year class, *Ns* = number of fish stocked for the same year class, and t = average time elapsed, in years, between stocking and capture for the *Nc* fish (Van Den Avyle and Higginbotham 1979). Pearson's correlation coefficient was used to analyze relative annual mortality versus stocking density.

Production and distribution expenses for larval and fingerling stockings were obtained from the Fish Hatcheries Branch (TPWD) and did not include broodfish procurement cost, which would be the same for both techniques. Cost effectiveness was determined by comparing larval and fingerling production expenses to stocking success determined by the gill net CPUE and mean total length of age-2 hybrids.

Results and Discussion

Gill net CPUE of age-2 hybrids was higher than other age classes during this study (Table 1). Mean annual CPUE for age-2 hybrids ranged from 1.53 to 2.27 per net night. No significant difference was found between CPUE of age-2 fish stocked as larvae vs. fingerlings.

Mean total length of age-2 hybrids from larval stockings was significantly greater than mean length of age-2 hybrids from fingerling stockings (Table 2). Hybrids from stockings of larvae may have been able to better utilize the zooplankton present in Sam Rayburn Reservoir at the time of their stocking than the hybrid fingerlings stocked approximately 8 weeks later. This factor could result in better initial growth, which in turn would have allowed these hybrids to switch to a piscivorous diet sooner. Summers (1987) reported higher and more consistent returns of fingerlings from Oklahoma hatchery ponds stocked with 2-day-old larvae rather than 6-day-old larvae. These larvae, which had both yolk sac and mouth parts,

Table 1. Mean annual gill net catch rates (number per net night) of hybrid striped bass (♂ *Morone chrysops* × ♀ *M. saxatilis*) by year class and age, Lake Sam Rayburn, Texas, 1981–89.

Year Class	Stage Stocked	Age 1	2	3	4	5
1979	F[a]	0.00	1.53[c]	1.07	0.27	0.13
1981	F	1.46	2.25	1.33	0.00	0.20
1982	L[b]	1.27	1.89	0.00	0.33	1.13
1985	L	0.47	2.27	0.20	0.40	
1987	L	0.27	1.93			

[a]Fingerlings.
[b]Larvae.
[c]No estimate of variation is available because data were not separated by station.

Table 2. Numbers stocked (*Ns*), numbers captured by gill net (*Nc*), relative mortality estimates (RM), and average total length in mm (ATL) at 1.75 years following stocking of hybrid striped bass (♂ *Morone chrysops* × ♀ *M. saxatilis*) in Lake Sam Rayburn, Texas.

Year Class	*Ns*	Stage Stocked	*Ns*	RM	ATL (Range)
1979	541,400	F[a]	23	5.78	443.3 (420–495)
1981	447,528	F	27	5.55	449.4 (415–496)
1982	1,000,000	L[b]	34	5.88	444.8 (414–470)
1985	1,000,000	L	31	5.93	463.5 (438–495)
1987	1,500,000	L	29	6.20	462.4 (430–485)

[a]Fingerlings.
[b]Larvae.

apparently were able to acclimate to pond conditions prior to active feeding better than the older larvae.

Relative annual mortality estimates increased significantly as the number of fish stocked increased indicating, as should be expected, higher mortality of the larvae (Table 2). Although mortality of hybrid larvae were greater than fingerlings, the similar recruitment and faster growth of larvae offset the higher mortalities.

Estimated production costs per hectare for fingerlings (exclusive of costs associated with obtaining broodfish) were $0.59 in 1979 and $0.49 in 1981, while larval production costs per hectare varied from $0.16 (1982, 1985) to $0.22 (1987). This indicated that larvae were less than half as expensive as fingerlings for establishing a hybrid population in the reservoir.

This study indicates that hybrid populations can be established in reservoirs by stocking 3-day-old larvae. The fishery in Sam Rayburn Reservoir was established by stocking approximately 20 larval hybrid striped bass per ha. Stocking 3-day-old hybrid larvae directly into reservoirs can substantially reduce hybrid striped bass production and distribution costs and allow hatchery ponds to be used for other fish species. The shorter cycling time in the hatchery (3 days vs. 5 days) would allow more larval production, because more broodfish could be used during the period when brooders are most eligible for spawning. Distribution costs would also be reduced because larvae are transported in oxygenated plastic bags and do not require the use of large hauling units.

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